

# AN501: SCM5B37

## Application Note: Thermocouple Voltage-To-Temperature Conversion Method

When the SCM5B37 thermocouple modules are used to measure temperature, the measured output voltage must often be converted back to temperature. This is readily done with the SCM5B37 series because cold junction compensation is incorporated into the module and the SCMPB backpanels.

The method is illustrated here with an example.

A type "K" thermocouple is to be used with the SCM5B37K.

SCM5B37K input and output ranges:	<u>Temperature Input</u>	<u>Voltage Output</u>
	-100°C	0VDC
	+1350°C	+5VDC

1. From the type "K" thermocouple tables we find the following voltages:

$$\begin{aligned} -100^{\circ}\text{C} &= -3.554\text{mV} \\ +1350^{\circ}\text{C} &= 54.138\text{mV} \end{aligned}$$

The SCM5B37K module gain (G), is given by:

$$G = V_{\text{out full scale range}} / \text{Thermocouple full scale range in volts}$$

$$\text{Therefore: } G = 5 / [ 0.054138 - (-0.003554) ] = 86.67 \text{ V/V.}$$

2. Calculate the effective thermocouple input voltage ( $V_t$ ) from the measured output voltage ( $V_{\text{out}}$ ) by the following formula:

$$V_t = (V_{\text{out measured}} / G) + \text{Thermocouple neg. full scale in volts}$$

$$\text{Therefore: } V_t = (V_{\text{out}} / 86.67) + (-0.003554)$$

3. Find the value of the field temperature being measured by crossing  $V_t$  to thermocouple temperature in your application program's thermocouple lookup table.

Gains for other SCM5B37 thermocouple modules are shown in the following table.

<u>Module type</u>	<u>Range (°C)</u>	<u>Module Gain G (V/V)</u>	<u>Thermocouple Neg. Full Scale (mV)</u>
SCM5B37J	-100 to 760	105.15	-4.633
SCM5B37K	-100 to 1350	86.67	-3.554
SCM5B37T	-100 to 400	206.18	-3.379
SCM5B37E	0 to 900	72.69	0.0
SCM5B37R	0 to 1750	239.50	0.0
SCM5B37S	0 to 1750	270.23	0.0
SCM5B37B	0 to 1800	367.89	0.0

For example, the following formula and values would be used for a type "J" thermocouple:

$$V_t = (V_{\text{out}} / 105.14) - 0.004632.$$

Where  $V_{\text{out}}$  is the module output voltage in volts and  $V_t$  is the thermocouple voltage referenced to a 0°C cold junction; that is, the voltage given in published tables.